Available online at www.sciencedirect.com

SciVerse ScienceDirect

Systems Engineering Procedia 2 (2011) 122 – 130

Procedia Systems Engineering

Research on Grey Decision Model of FDI Pre-evaluation Index System※

Yulin Liu[a], Yuyan Liu[b], Yongqiang Lin[a], Qing Zhao[b] *

[a]*Chongqing University, Chongqing 400044, China*
[b]*Kunming College, Kunming 650214, China*

Abstract

Nowadays, accelerating the transition from quantity to the quality of introduced FDI, and improving the quality of FDI are one of the most important ways to promote the economic growth, thus, how to comprehensively evaluate the quality of introduced FDI is a problem need to be solved. Suggest that it is proposed in this article the construct of FDI pre-evaluation index system from comprehensive welfare effect perspective, emphasizing "welfare effects" and "pre-evaluation", to make whole evaluation index system comprehensive and rationality. Aiming at the fuzziness of the value of pre-evaluation index, we inherited the theories and methods of Grey System Theory into the Evaluation Decision Analysis, then built Grey Decision Model according to reliability engineering and achieve grey decision effectively and accurately by applying VB program. Finally, examples support that this method is feasible and credible to FDI pre-evaluation, that not only solve the problem of uncertainty and fuzziness, but also provide reliable guarantee to every region to make the change from attracting investment to selecting investment and FDI engineering management.

Keywords: FDI; Pre-evaluation; Immiserizing growth; Welfare effect; Grey correlation decision model; FDI engineering management

1. Introduction

In recent years, FDI (Foreign Direct Investment) is worshipped in many places blindly, that has become an increasingly serious problem. Local government only focus on the promoting function of FDI to the economic growth, neglecting the negative effects of FDI, and does not understand the complex effect of FDI comprehensively. In the process of introducing FDI, the government pays attention to quantity rather than quality, and makes a clearance sale on natural resources, environment, market and even government tax in a competitive way. The bias of this policy and behavior to attract foreign investment virtually increases the hidden trouble of "immiserizing growth". Comparing with Bgawati's immiserizing growth conditions and China's foreign trade development and economic aggregates index in recent two decades, Chinese scholars think the conditions of both are basically in consistent with each other, and conclude that China's foreign trade development pattern belongs to immiserizing growth or is faced with the danger of it. However, some scholars have discovered that the terms of trade in our country have been deteriorated but have not lead to immiserizing growth [1]. Along with the arrival of post-crisis era, the industrial restructuring and low-carbon economic development will make a significant FDI growth and may become a hot spot to promote a new round of FDI growth [2]. Facing with new situation and scholars' inconsistent conclusions, the subject reexamines the position of FDI in China economy and believes that only by processing the relation among FDI, the welfare effect and the sustainable development of economic correctly can make a properly judgement whether it causes immiserizing growth in the host country. It requires a scientific evaluation of FDI, not only the evaluation of use of FDI quality, but also evaluates the level of introducing FDI (FDI project ex-ante evaluation [3]), the framework of FDI quality evaluation as shown in figure1.

At present, most research relates to the FDI quality evaluation, but the research of FDI project ex-ante evaluation is almost empty, this paper focuses on the FDI project ex-ante evaluation: constructing FDI project ex-ante evaluation index system from comprehensive welfare effect perspective; introducing the gray system theory ideas and methods to the evaluation and decision analysis and establishing grey relational analysis model; achieving the grey analysis through VB programming conveniently, rapidly, accurately. It can implement a leap from attracting investment to selecting investment.

※This article was funded by National Natural Science Fund Project of National Natural Science Foundation of China 2010, (71073179).
* Corresponding author. Tel.:0086-023-65111101; fax: 0086-023-65111108.
E-mail address: lylmx@cqu.edu.cn; yqlin@126.com.

2211-3819
doi:10.1016/j.sepro.2011.10.015

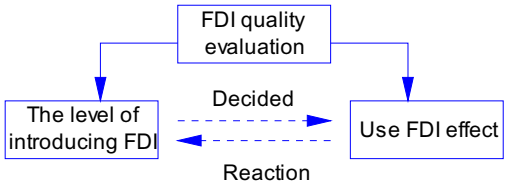

Figure 1 The framework of FDI quality evaluation

2. Constructing FDI project ex-ante evaluation index system base on comprehensive welfare effects perspective

2.1. The Introduction of comprehensive welfare effects

Bgawati, the Indian economist, believed that the increase of production and income which is brought by economic growth in developing countries may be offset by worsening terms of trade and results in absolutely decline of people's real income and consumption levels. This is the famous "immiserizing growth" proposition. However, domestic scholars through empirical illustrate that terms of trade are not suitable for measuring the level of FDI inducing immiserizing growth. They deem that measuring poverty growth should evaluate from the perspective of welfare effects.

In view of welfare connotation, it pays attention to the current condition and satisfaction of life. In order to keep the basic ability operational——maintaining welfare level not decrease in a long period, economists evolve this maintenance into keeping all the capital value (that is, basic conditions) the same, the capital usually contains manufacturing capital, human capital, natural capital and social capital. This suggests that the fixed assets investment, labor skills training, resources occupation and environmental pollution degree, employment and trade competitiveness have direct relationship with welfare level. Domestic and foreign scholars make studies between FDI and welfare effect from different views. For example, the literature 4 purports to examine the consequences of foreign direct investment(FDI) in agricultural land in a developing economy using a three-sector general equilibrium model and finds that FDI in agriculture does not only improve national welfare unequivocally but also mitigates the unemployment problem of both skilled and unskilled labour. Reference 5 proposed elements of terms of trade was a valid indicator of measure of changes in welfare. The literature 6 pointed out the comprehensive influence of the host country's welfare by attracting FDI was not ascertain, when formulate policies to attract FDI the governments at various levels could not blindly pursue "FDI maximization" and waste valuable resources but should set up certain restrictions to FDI if necessary. Using household survey data in Senegal, literature 7 studies the relationship between foreign investments and welfare. And it finds significant positive welfare impacts of FDI through employment creation and labor market participation. Literature 8, using three-sector general equilibrium model, finds that a policy of overall economic growth in the form of an FDI (foreign direct investment) is indeed able to put downward pressures on the child labour problem, and welfare of the child labor-supplying families also improves.

2.2. FDI project ex-ante evaluation index system from comprehensive welfare effect perspective

Based on the scholars' research and combined with the reality of our country and the characteristics of attracting FDI, we hold the view that the FDI evaluation index system on welfare effect should adopt to both of the combinations: subjective and objective indicator, qualitative and quantitative methods. In view of the subjective drawbacks of sub-indicators and index selection in the index system construction process, the subject of the welfare effect of FDI by domestic and foreign scholar: economic effects, social effects, technical effects and ecological effects of four-dimensional degree into the evaluation system, and uses UML method to select target item and build index system model [9]. The comprehensive index of FDI project ex-ante evaluation is shown in Figure 2. Relevant interpretation of each indicator in figure 2 is shown in table 1.

The "value" column in table 1 has qualitative and quantitative value. We make quantitative treatment to the qualitative value and divide these indicators into several levels by giving different quantity, generally dividing into five levels, and then transform into quantitative target using numerical 1, 3, 5, 7, and 9.

There are positive and negative effects for "effect" column. The target value bigger, the so-called positive effect index better. The target value smaller, the negative effect index better.

2.3. Define FDI project ex-ante evaluation index weight vectors

The definition of the weight of index could adopt the qualitative analysis method, such as expert consultation method, Delphi method, sorting method, the weighted evaluation method, etc; quantitative analysis method, such as mathematical analysis, the principal component analysis, the grey correlation evaluation method, neural network evaluation method, etc; comprehensive analysis method, such as layer analysis method, fuzzy comprehensive evaluation, gray system theory method, etc.

FDI project ex-ante evaluation has many uncertain and fuzzy factors, therefore, the index weight also cannot be exactly sure of characteristics. The subject uses binary compared relative average method to determine the weights [10].

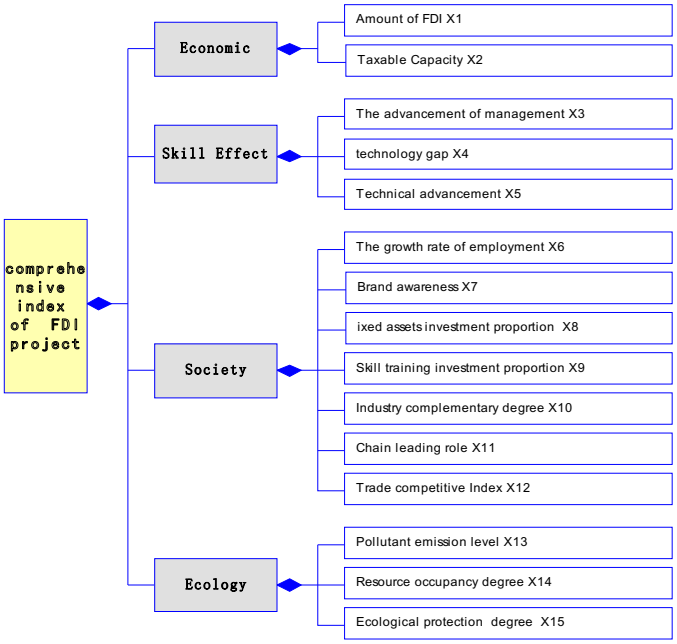

Fig. 2. FDI former evaluation index system

Table 1 Interpretation of FDI evaluation index on comprehensive welfare effect

Index	Welfare effect to host countries	value	effect
X1	Measurement of gross national welfare usually bases on GDP, FDI investment and per capita GDP growth rate make a positive correlation. FDI investment is the basic element of measuring the FDI quality and also reflects the material basis of national welfare gain.	Plan value (ten million Yuan)	Positive effect
X2	Excessive tilt of tax preferential policy is bound to reduce the positive benefits of FDI on host country, result in the loss of government revenue and increase regional economic development gap [11]. Strong ability to pay taxes could increase local fiscal revenue and then increase social economic welfare expense.	Pianissimo, feeblish, general, stronger, fortissimo	Positive effect
X3	Absorbing foreign advanced management experience can improve the management level of host countries. The advanced management experience of FDI can spread to the same industry, upstream and downstream relevance to domestic enterprises in the operating process and play a positive role to the local enterprise management.	Domestic level, advanced domestic level, leading domestic level, advanced international level, leading international level	Positive effect
X4	The gap between technology level of host country and attracting FDI determines the size of absorbing capacity. The greater the gap, the lower the consumption growth rate, and then damage the welfare level of nation [12]. Considering the technical level of domestic and introducing high technology reasonably could promote technical absorptive and innovational capacity in the host country [13].	Pianissimo, feeblish, general, stronger, fortissimo	Negative effect
X5	The main factor of influence national welfare is whether the host country itself could quickly boost its technical level. Advanced technology is beneficial to enhance the local production technology and technical level of product, and then improves the comprehensive factor productivity of national economy in the host country.	Domestic level, advanced domestic level, leading domestic level, advanced international level, leading international level	Positive effect
X6	The employment rate is the true, reliable and important symbol of national welfare. Generally, total factor productivity caused by FDI entering can raise salary and increase employment in the same wage. Increase of employment and average wage rate boosts local human resource utilization, raises the income level and increases society's welfare.	Plan value (%)	Positive effect
X7	Brand is the key element for long-term survival and development of enterprise. On the one hand, it create independent brand actively (a lack of independent brand is a immiserizing growth) [14], on the other hand, use of foreign brand awareness effect drives the local related products brand.	Domestic level, advanced domestic level, leading domestic level, advanced international level, leading international level	Positive effect
X8	Fixed assets investment to economic growth plays a direct role and development of investment pulls the demand of raw material, production equipment, labor, etc. Thus, it leads to the increasing of industry production and consumption demand which related to investment activities.	Plan value (%)	Positive effect
X9	The root of enterprise participating in the market competition is talent. One of the keys for the advanced technology transferring into productivity needs large quantities of high skill technical workers. Foreign company's training will directly promote or incentive to promote its individual human capital accumulation level of workers. It has diffusion effect to local talent cultivation and also improves the social welfare.	Plan value (%)	Positive effect

X10	Usually, foreign-funded industry is mainly concentrated in the secondary industry, and the industrial structure is irrational in the second and tertiary industries. A high degree complementarily of industry will improve the local industrial structure, especially the industry which does not have the ability to development in the short term, and improve the comprehensive competitive power.	Pianissimo, feeblish, general, stronger, fortissimo	Positive effect
X11	Foreign-funded industry competes with enterprise which product similar produces in the host country. It reduces the profit of domestic enterprise, but drives the demand of other domestic products. As a result, other domestic manufactures get profit and the related local industries obtain growth and improvement.	Pianissimo, feeblish, general, stronger, fortissimo	Positive effect
X12	Trade competitiveness index, a common indicator, is measured one country's trade competitive advantage. The greater value means the country has stronger competitive advantage on this product and stronger export competitiveness.	Pianissimo, feeblish, general, stronger, fortissimo	Positive effect
X13	The emission degree of industrial waste water, industrial solid waste, industrial waste gas and industrial dust, etc, has become a main cause of environmental deterioration.	Very low, lower, general, higher, very high	Negative effect
X14	The dramatically increased resource (natural resource, especially the non-renewable resource) consumption has become maximum limit to China's economic and social sustainable development and threaten national security directly.	Very low, lower, general, higher, very high	Negative effect
X15	Protecting the ecological environment and improving the quality of life is the human target. The development and application of technology, which make energy saving, consumption reduction and emission reduction, is the specific performance of ecological protection degree. Saving energy and reducing consumption has become an important means to ease the contradiction between supply and demand. Reducing emissions also has become an important means to improve survival environment.	Domestic level, advanced domestic level, leading domestic level, advanced international level, leading international level	Positive effect

Support $X=(x_1,x_2,\cdots,x_n)$ is factor set. Considering the objective position and the role of all factors and according to its importance——a fuzzy property concept, set up fuzzy relation $R(x_i,x_j)$ between two elements on X and then defined $R(x_i,x_j)$ as:

$\begin{cases} R(x_i,x_j)\underline{\Delta}f_{xj}(x_i) \\ R(x_j,x_i)\underline{\Delta}f_{xi}(x_j) \end{cases}$, $f_{xj}(x_i)$ and $f_{xi}(x_j)$ are binary comparative degree, they meet $\begin{cases} 0\le f_{xj}(x_i),f_{xi}(x_j)\le 1 \\ f_{xj}(x_i)+_{xi}(x_j)=1 \end{cases}$, decision makers, according to the importance of two elements in factor set, designate the concrete value by contrast and weigh.

Define the fuzzy relation $R(x_i,x_j)(j=1,2,\cdots,n)$ to x_i, and then use of average method to obtain the total importance of factors, which is $f(x_i\mid X)\underline{\Delta}\sum_{j=1}^{n}\frac{1}{n}R(x_i,x_j),(i=1,2,\cdots,n)$.At the end, normalize the above results and gain the weight of each factor $w_i=f(x_i\mid X)/\sum_{i=1}^{n}f(x_i\mid X)$.

According to the relative compared average method of binary, get weight as shown in Table 2 in this subject:

Table 2 index and weight in three class

index	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15
weight	8	6	6	7	7	7	6	6	7	6	5	7	7	7	8

3. Build grey related decision model

3.1. Outline project evaluation methods

Commonly a lot of factors are involved (social, economic, environmental, and so on) in the FDI project. The relationship of each index is more complex, so people cannot obtain comprehensive, enough information and form clear concept easily in the actual analysis and decision process. These factors tend to show the characteristics of uncertainty and fuzziness, even some quantitative index also shows different degree of uncertainty and fuzziness because of the work of grey factor and grey correlation. In addition, the subjective consciousness of the decision maker is also worth considering. These uncertainty factors increase evaluated difficulties to the FDI project. This information system which is partly clear and partly unclear is called "the gray system". Its main features are: (1) complexity, because the FDI project involves effect in many aspects, and the effect still exists information cross. (2) uncertainty, the spillover of FDI effect and extrusion influents each other, that makes difficult for people to set its internal structure and grasp the trend of its development.

From the domestic and foreign research showed, particular in recent years, although project evaluation technology research has made new progress, the study of evaluation is still inadequate. (1) in the project evaluation methods, less of evaluation method according to the characteristics of FDI project; (2) in the whole project evaluation, lack of systematic, too multifarious and scatter of evaluation content and method, lack of necessary integration and all lead to unable to form a complete and clear science evaluation method to choose project ex-ante, such as using of entropy method evaluates objectively to the weight of each index coefficient of investment project [15],and evaluates the innovation project from risk and benefit aspects[16]. The research specifically on the FDI evaluation criteria mainly focuses on evaluating the FDI quality problem [17]-[19], and neglects evaluating

FDI quality itself; despite the scholars evaluate FDI quality from the introduction of FDI level and utilizing FDI effect, its evaluation involves only the FDI economic benefits and lacks of FDI welfare effect.

In 1982, Julong Deng professor founded the gray system theory. Gray decision is an important part of gray system. Gray correlation analysis is a statistical analysis method concerning many factors, it bases on the sampled data of the factors. Though gray correlation degree, we can analyze and determine the influential degree of the system factors or the contribution of the factors to the main system behavior. Gray correlation degree describes the relative changes of the factors, which are the relativity of the size, direction and velocity of the change. If the relative change is similar, we consider the level of association between the factors is high and vice versa. Correlation degree is the measurement of relevance of things and factors. It finds relevance out of randomized sequences to provide basis for decision making and methods for deciding main factors. Gray correlation analysis is an analytical method to perform strength analysis and to solve uncertain decision problems through gray correlation degree. Correlation degree is used to describe the relevance of factors; it is a measurement of the change trend of the system. We can decide the order of the evaluation items by strength analysis according to the gray correlation degree.

There are always some uncertainty and blurring factors in actual overall policy making process and they can directly influence the decision makers to make an appropriate decision. Gray system theory happens to be a reasonable and workable method to study and solve this kind of problems. The difference between information theory and the principle of not-only solution reflects the uncertainty of the FDI project evaluation. The evaluation system is a typical gray system; it has the characteristic of information uncertainty just like the gray system. From the perspective of the welfare effects of FDI, this article introduces the theory and methods of gray system into the analysis of FDI project evaluation, aiming to find an effective way of assessment for the decision makers.

3.2. Gray correlation decision model

Gray correlation decision model bases on the actual background, finds the effect evaluation vector of the optimal project, and decides the order of the projects by comparing the gray correlations degree between each project and the optimal project. Because of this, gray correlation decision is not a functional model; it is an order relation model. The technical connotation is: get the differential information of the sequences, establish differential information space; establish and calculate differential information relative measurement; establish the order relation of the factors. If we take the factors of the system factor set as the dots of space, the corresponding observation data as the coordinates of the dot, we can study the factors or the relationship between factors and system characteristics in an n-dimensional space and define gray correlation degree through the distance in the n-dimensional space. The correlation degree is a measurement of the distance between discrete functions, but it emphasizes the relative distance of many discrete functions to a single function, the value of correlation degree is not important, the important is comparing the influence of each subsequences to the same main sequence. Gray correlation analysis puts all factors into one system to compare and analyze, and breaks the frame of comparing only two factors in the normal system analyses, whiten the uncertainty relationship of evaluated factors, reduced the influence of subjective factors, and improves the accuracy of conclusion evaluation.

Suppose $X_0 = (x_0(1), x_0(2), \cdots, x_0(n))$ is the reference sequence of behavior index of evaluated project and $X_i = (x_i(1), x_i(2), \cdots, x_i(n)), i = 1,2, \cdots, m$ is the relative sequence.

Definition 1: suppose $X_i = (x_i(1), x_i(2), \cdots, x_i(n)), i = 1,2, \cdots, m$ is index sequence of FDI project, D is sequential operator, and $X_i D = (x_i(1)d, x_i(2)d, \cdots, x_i(n)d)$, and $x_i(k)d = \frac{x_i(k)}{\overline{X_i}}$, $\overline{X_i} = \frac{1}{n}\sum_{k=1}^{n} x_i(k); k = 1,2, \cdots, n$, then D is average arithmetic operator, $X_i D$ is the image of X_i under average arithmetic operator D, which is called equalization image for short.

Theorem 1: suppose sequences X_0 and X_i have the same length, then $\varepsilon_{0i} = \frac{1+|s_0|+|s_i|}{1+|s_0|+|s_i|+|s_i - s_0|}$ is the definite gray correlation degree of X_0 and X_i. And $|s_0| = |\sum_{k=2}^{n-1} x_0(k) + \frac{1}{2}x_0(n)|$, $|s_i| = |\sum_{k=2}^{n-1} x_i(k) + \frac{1}{2}x_i(n)|$, $|s_i - s_i| = |\sum_{k=2}^{n-1}(x_i(k) - x_0(k)) + \frac{1}{2}(x_i(n) - x_0(n))|$ $x_0(k) = x_0(k) - x_0(1), \quad x_i(k) = x_i(k) - x_i(1)$.

Definition 2: all the FDI projects that needed to be valued are called the set of events, noted as $A = \{a_1, a_2, \cdots, a_n\}$, among which $a_i (i = 1,2, \cdots, n)$ is number i event; all the possible evaluation indexes are called the strategy set, noted as $B = \{b_1, b_2, \cdots, b_m\}$,, among which $b_i (i = 1,2, \cdots, m)$ is the number j strategy.

Definition 3: suppose $S = \{s_{ij} = (a_i, b_j) \mid a_i \in A, b_j \in B\}$ is a situation set, $u_{i_0 j_0} = (u_{i_0 j_0}^{(1)}, u_{i_0 j_0}^{(2)}, \cdots, u_{i_0 j_0}^{(s)})$ is the optimal effect vector; if $u_{i_0 j_0}$ corresponds to $s_{i_0 j_0} \notin S$, then $u_{i_0 j_0}$ is called the optimal effect vector, $s_{i_0 j_0}$ is called the optimal situation.

Proposition 1: suppose $S=\{s_{ij}=(a_i,b_j)\,|\,a_i\in A,b_j\in B\}$ is situation set, effect vector $u_{ij}=(u_{ij}^{(1)},u_{ij}^{(2)},\cdots,u_{ij}^{(s)});i=1,2,\cdots n;j=1,2,\cdots,m$ is corresponding to situation s_{ij}, then:

when the value of index k is the more the better, take $u_{i_0j_0}^{(k)}=\max\limits_{1\le i\le n,1\le j\le m}\{u_{ij}^{(k)}\}$

when the value of index k near some moderate value u_0 is better, take $u_{i_0j_0}^{(k)}=u_0$

when the value of index k is the smaller the better, take $u_{i_0j_0}^{(k)}=\min\limits_{1\le i\le n,1\le j\le m}\{u_{ij}^{(k)}\}$

then $u_{i_0j_0}=(u_{i_0j_0}^{(1)},u_{i_0j_0}^{(2)},\cdots,u_{i_0j_0}^{(s)})$ is the optimal effect vector.

Proposition 2: suppose $u_{i_0j_0}=(u_{i_0j_0}^{(1)},u_{i_0j_0}^{(2)},\cdots,u_{i_0j_0}^{(s)})$ is situation set, effect vector $u_{ij}=(u_{ij}^{(1)},u_{ij}^{(2)},\cdots,u_{ij}^{(s)})$; $i=1,2,\cdots n;j=1,2,\cdots,m$ is corresponding to situation s_{ij}, the optimal effect vector is $u_{i_0j_0}=(u_{i_0j_0}^{(1)},u_{i_0j_0}^{(2)},\cdots,u_{i_0j_0}^{(s)})$, $\varepsilon_{ij}(i=1,2,\cdots n;j=1,2,\cdots,m)$ is the definite gray correlation degree of u_{ij} and $u_{i_0j_0}$, if $\varepsilon_{i_1j_1}$ can fulfill that to any $i\in\{1,2,\cdots n\}$, $i\ne i_1$ and $j\in\{1,2,\cdots m\}$, $j\ne j_1$, $\varepsilon_{i_1j_1}\ge\varepsilon_{ij}$ can always be established, then $u_{i_1j_1}$ is subprime effect vector, $s_{i_1j_1}$ is subprime situation.

3.3. Process of establishing gray correlation decision model

The basic steps of evaluating FDI by gray correlation decision model are: take the optimal indexes of FDI project (or the best values of the FDI projects that are been evaluated) as the indexes $x_0(k)$ of reference sequence X_0, the indexes of the evaluated project as the indexes $x_i(k)$ of relative sequence X_i, calculate the correlation degree ε_{ij}. The deeper the correlation, the better the FDI effect and vice versa. So the correlation between situation effect vector and optimal effect vector is a criterion to evaluate the situation. That is to say, the order of the correlation degree is order of the investment effect of different FDI projects.

Process of establishing gray correlation decision model are seen in figure 3.

3.4. Using VB to achieve gray correlation decision

VB (Visual Basic) is a visual programming language. Using it to achieve the calculation of correlation degree can make situation evaluation quick and accurate, and visual operation interface is easily operable. The main code segments are as follows:

(1)Calculate the starting point of zero

Array A storage subtraction of original data; variable m storage evaluation object; variable n storage index item; Array s storage experts given scores.

```
For i = 0 To m
  For j = 1 To n
   a(i, j) = s(i, j) - s(i, 1)
  Next j
Next i
```

(2)Calculate |s0|,|si|

Use array column a(i, 0) to save |s0|,|si|

```
For i = 0 To m
  a(i, 0) = 0
  For j = 2 To n - 1
    a(i, 0) = a(i, 0) + a(i, j)
  Next j
  a(i, 0) = a(i, 0) + a(i, n) / 2
Next i
```

(3)Calculate definite gray correlation degree

Use array e0 to save absolute correlation

```
For i = 1 To m
  e0(i) = (1 + Abs(a(0, 0)) + Abs(a(i, 0))) / (1 + Abs(a(0, 0)) + Abs(a(i, 0)) + Abs(a(0, 0) - a(i, 0)))
Next i
```

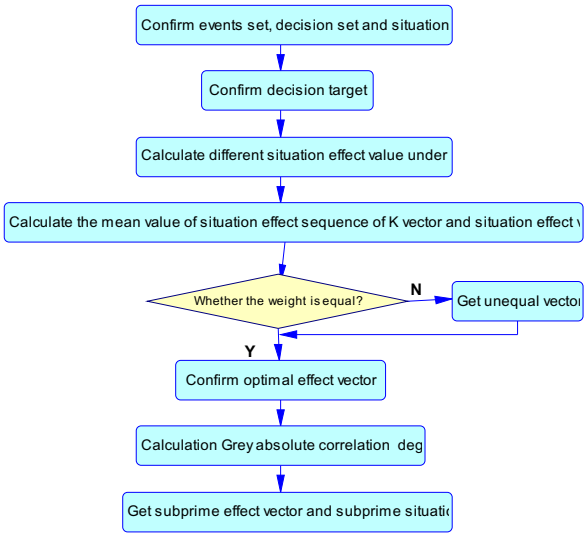

Fig. 3. Process of establishing gray correlation decision model

4. An instance of related decisions of the evaluation model of FDI

An area introduces a policy issue of FDI project: there are three FDI investment projects (scheme) which need to be evaluated to determine which project is the better decision, The data of three projects are showed in table 3.

Step of Grey relation decision as follow:

1) confirm events set. Take the FDI project evaluation as event a1 so event set A = {a1}, choose Project 1,Project 2,Project 3 as countermeasure b1,b2,b3 respectively , so countermeasure set B = {b1,b2,b3}; Situation set $S = \{s_{ij} = (a_i, b_j) \mid a_i \in A, b_j \in B\} = \{s_{11}, s_{12}, s_{13}\}$

2) confirm decision target set. According to evaluation index, confirm 15 targets.

3) The situation effect matrix sequence U, Effect flag matrix flag and Weight matrix weight as follow respectively:

$$U = \begin{bmatrix} 2.70 & 2.09 & 2.54 \\ 5 & 3 & 9 \\ 5 & 7 & 3 \\ 5 & 7 & 3 \\ 3 & 3 & 7 \\ 30 & 20 & 25 \\ 3 & 1 & 3 \\ 7 & 4 & 5 \\ 4 & 2 & 3 \\ 5 & 7 & 3 \\ 3 & 5 & 7 \\ 7 & 9 & 3 \\ 3 & 5 & 7 \\ 7 & 1 & 3 \\ 7 & 3 & 5 \end{bmatrix} \quad flag = \begin{bmatrix} 1 \\ 1 \\ 1 \\ -1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ -1 \\ -1 \\ 1 \end{bmatrix} \quad weight = \begin{bmatrix} 8 \\ 6 \\ 6 \\ 7 \\ 7 \\ 7 \\ 6 \\ 6 \\ 7 \\ 6 \\ 5 \\ 7 \\ 7 \\ 7 \\ 8 \end{bmatrix}$$

4) Calculate the mean value of situation effect sequence of K vector and effect vector $u_{ij}(i = 1; j = 1,2,3)$ of situation s_{ij} .

5) Calculate Optimal effect vector.

6) Calculate Grey definite correlation degree $\varepsilon_{ij}(i = 1; j = 1,2,\cdots,15)$ of u_{ij} and $u_{i_0 j_0}$

Table 3 The data of three projects

index	Project 1	Project 2	Project 3
Amount of FDI investment (ten million Yuan)	2.70	2.09	2.54
Ability to pay taxes	general	feeblish	fortissimo
Advancement of management	leading domestic level	advanced international level	advanced domestic level
technology gap	general	stronger	feeblish
Technical advancement	advanced domestic level	advanced domestic level	advanced international level
The growth rate of employment (%)	30	20	25
Brand awareness	advanced domestic level	domestic level	advanced domestic level
Fixed assets investment proportion (%)	7	4	5

Skill training investment proportion (%)	4	2	3
Industry complementary degree	general	stronger	feeblish
Chain leading role	feeblish	general	stronger
Trade competitive Index	stronger	fortissimo	feeblish
Pollutant emission level	lower	general	higher
Resource occupancy degree	higher	Very low	general
Ecological protection degree	advanced international level	advanced domestic level	leading domestic level

Apply the program of VB, the running results are showed in graph 4:

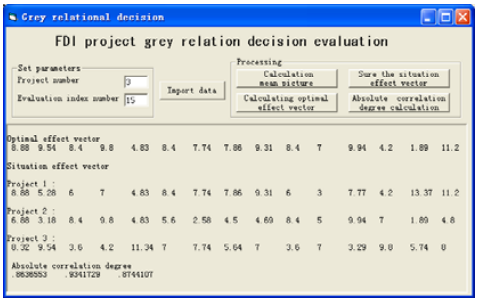

Fig. 4. The running results

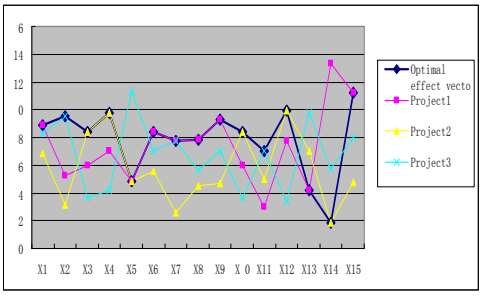

Fig. 5. the degree of each project closing to optimal effect vector

According to the definition of Grey correlation decision, $\max\{\varepsilon_{ij}\} = \varepsilon_{12} = 0.9341729$, so u12 is subprime effect vector, s12 is subprime situation, which means Project B is the optimized choice project, the degree of each project closing to optimal effect vector is showed in Graph 5:

The blue thick line represents optimal effect vector. We can see from the graph, indexes of these three evaluated projects have intersection with optimal effect vector, it's hard to observe subprime situation vector directly from graph, but through the calculation of the dependent degree of the grey relational decision, it can be sure that the project B is the most close to the optimal effect vector, which is the subprime situation vector.

5. Conclusion

This paper aims at the bias of the capital investment policy and the behavior and the fact of "poverty growth" hidden trouble, studies from two respects: ①Suggest that construct FDI pre-evaluation index system from comprehensive welfare effect perspective, emphasizing "welfare effects" and "pre-evaluation", to make whole evaluation index system comprehensive and rational. ②Aiming at the fuzziness of the value of pre-evaluation index, introduce the theories and methods of Grey System Theory into the Evaluation Decision Analysis, then built Grey Decision Model and achieve grey decision effectively and accurately by applying VB program. Finally it uses examples to prove that this method is feasible and credible to FDI pre-evaluation, which not only solves the problem of uncertainty and fuzziness, but also provides reliable guarantee to every region to make the change from attracting investment to selecting investment.

6. Copyright

All authors must sign the Transfer of Copyright agreement before the article can be published. This transfer agreement enables Elsevier to protect the copyrighted material for the authors, but does not relinquish the authors' proprietary rights. The copyright transfer covers the exclusive rights to reproduce and distribute the article, including reprints, photographic reproductions, microfilm or any other reproductions of similar nature and translations. Authors are responsible for obtaining from the copyright holder permission to reproduce any figures for which copyright exists.

Reference

1. Guijun Lin and Yuqin Zhang, Deterioration of Terms of Trade and Immiserizing Growth: Evidence from China. Journal of International Trade. 1 (2007) 3-9.
2. San Baichuan, The future opportunity of FDI.China Economics Weekly. 1(2010)4.
3. Jinhai Li, Hui Liu and Junlin Zhao, The Review of Evaluation Methodology. Journal of HEBEI University of Technology. 33(2004)128-134.
4. Sarbajit Chaudhuri and Dibyendu Banerjee, FDI in agricultural land, welfare and unemployment in a developing economy. Research in Economics. 64(2010)229–239.
5. E. Kwan Choi and Hamid Beladi, Factor Accumulation And The Terms Of Trade: Applications To The Asian Financial Crisis. Pacific Economic Review. 11(2006)383-394.

6. Barros P and Cabral L, Competing for Foreign Direct Investment. Review of International Economics. 8 (2000)360-371.
7. Miet Maertens, Liesbeth Colen and Johan F.M. Swinnen, Globalization and Poverty in Senegal: A Worst Case Scenario?. European Review Of Agricultural Economics. 38(2011) 31-54.
8. Dwibedi, Jayanta and Chaudhuri, Sarbajit, Poverty alleviation programs, FDI-led growth and child labour under agricultural dualism. Munich Personal RePEc Archive (MPRA) Paper No. 29997. (2011). http://mpra.ub.uni-muenchen.de/29997/.
9. Yuyan Liu and Yulin Liu, The construction of index system based on UML and grey theory. Statistics and Decision. 15(2008)16-19.
10. Fan Wang and Yaoliang Zhang, Investigation About the weight and the Mothod of its Distribution. Systems Engineering. 9 (1993)11-14.
11. Na Chen, Research of weakening effect of tax preferential policy to China's FDI. Hanjiang Tribune. 11 (2008)113-117.
12. Reis and Ana Balcao, On the Welfare Effects of Foreign Investment. Journal of International Economics. 54 (2001)411- 428.
13. Chiara Fumagall, On the welfare effects of competition for foreign direct investment. European Economic Review. 47 (2003)963-983.
14. Jindong Yang, The Shadow of Government and the Lack of Autonomous Brand. Ji nan University, Ph.D. Thesis.2006.
15. Liyu Lu, The Optimization of Investment Projects Using Evaluation Method of Multi-level Entropy. Journal of Xihua University(Natural Science Edition). 4 (2009)86-88.
16. Torsten Bolhin, Practical Grey-Box Process Identification: Theory and Applications (Advances in Industrial Control). ISBN: 9781846284021. 2006.
17. Buckley, P.J.&J.Clegg & C.Wang, The Relationship Between Inward Foreign Direct Investment and the Performance of Domestically - owned Chinese Manufacturing Industry.The Multinational Business Review. 3(2004)37-38.
18. Magnus Blomstrom and Ari kokko, Foreign Direct investment and spillovers of technology. International Journal of Technology Management. Vol.22, No.5(2001).
19. Yuanhai Fu and Min'an Peng, The research on evaluation standard of China FDI Utilization Quality. Seeker, 11 (2007)20-23.